A review of single molecule-based electronic devices

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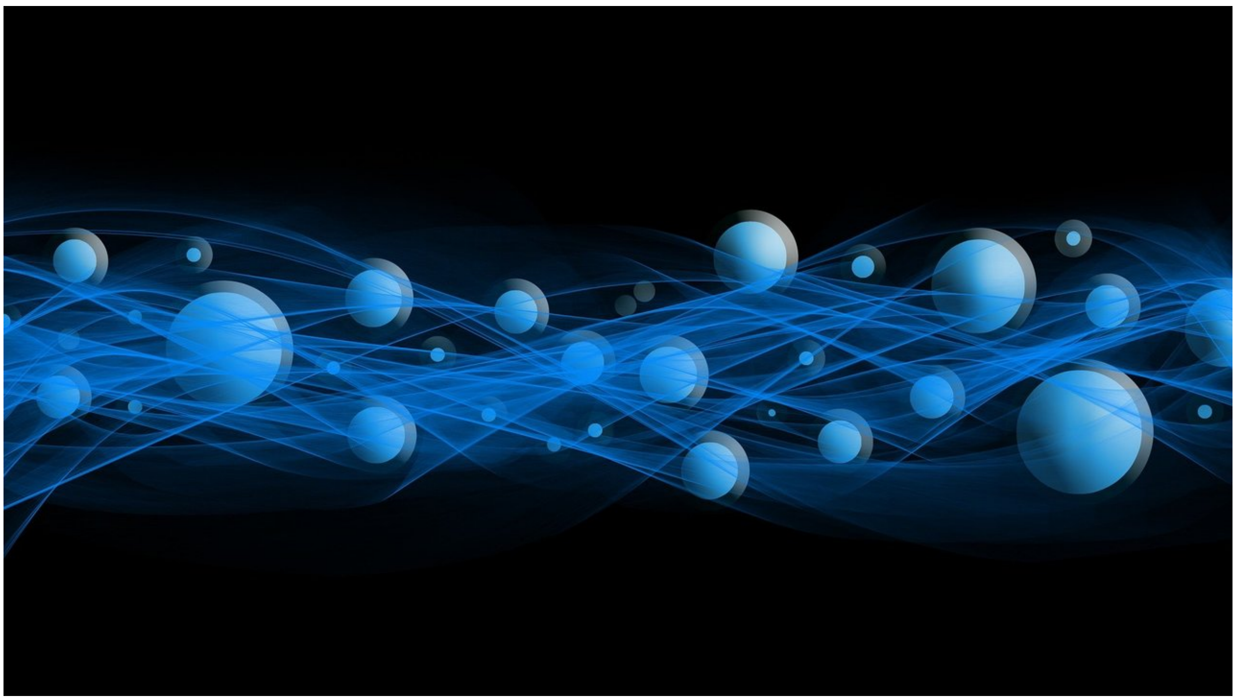

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In a paper to be published in the forthcoming issue of *Nano*, a group of researchers from the Shenyang Jianzhu University in China has provided an overview of single-molecule electronic devices, including molecular electronic devices and electrode types. They also describe future challenges to the development of electronic devices based on single molecules in the hopes of attracting more experts from other fields to participate in this research.

At present, traditional electronic devices based on semiconductor materials face severe challenges, not only technical and technological limitations, but also key theoretical limitations. With the rapid development of nanotechnology and in-depth research, researchers have made progress in the theory and practice of molecular electronic devices in recent years

Molecular electronic devices are devices that use molecules (including biomolecules) with certain structures and functions to build an ordered system in the molecular scale or supramolecular scale. They make use of the quantum effect of electrons to work, control the behavior of single electrons, and realize the functions of information detection, processing, transmission and storage, such as molecular diodes, molecular memories, molecular wires, molecular field effect transistors and molecular switches.

As a stable quantum system with abundant photoelectric properties, molecules have many electronic transport properties different from semiconductor devices. Molecular electronic devices have the following advantages: (1) small molecular volume, which can improve the integration and operation speed; (2) selecting appropriate components and structures can widely change the electrical properties of molecules; (3) molecules are easy to synthesize, and the required structure can be formed by a self-assembly method; and (4) the molecular scale is on the nanometer scale and has advantages in cost, efficiency, and power consumption.

With traditional silicon-based electronic devices becoming ever smaller, the impact of quantum effects is starting to emerge. Research on molecular electronics has made significant breakthroughs. Researchers are increasing their understanding of characteristics such as potential thermoelectric effects, new thermally induced spin transport phenomena and negative differential resistance, and believe that smaller, faster and "cooler" high-tech products will eventually be realized in the future.

However, current research work on molecular devices is still theoretical, and there is still much work to be done in terms of device manufacturing reliability, experimental repeatability, and manufacturing cost. Therefore, the purpose of this review is to attract more experts, scholars and engineers from fields such as chemistry, physics and microelectronics to participate in this research so that molecular electronic devices can become a reality as soon as possible.

More information: Bingrun Chen et al, Single Molecule-Based Electronic Devices: A Review, *Nano* (2019). DOI: 10.1142/S179329201930007X

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